



Unmanned Aerial Systems Traffic Management (UTM)

**SAFELY ENABLING UAS OPERATIONS
IN LOW-ALTITUDE AIRSPACE**

NEXTGEN

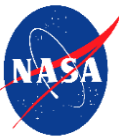
NASA

<http://www.utm.arc.nasa.gov>

Moffett Field, CA

Parimal.H.Kopardekar@nasa.gov

Successful Initial UTM Tests at 6 FAA Test Sites



Breaking News: 23 UAS at a time, many with live and virtual traffic successfully managed in UTM research platform – API based. More research will continue.

UTM Goal and Characteristics

- Conduct research, development and testing to identify airspace operations requirements to enable large-scale visual and beyond visual line of sight UAS operations in the low-altitude airspace
 - Collaborate with FAA, DOD, DOI, and DHS through Research Transition Team
 - Collaborate and leverage industry capabilities and insights
 - Partner with FAA test sites for testing
 - Partner with FAA COE for key research needs
- UTM uses build-a-little-test-a-little strategy – remote areas to urban areas
 - Low density: No traffic management required but understanding of airspace constraints
 - Cooperative traffic management – Understanding of airspace constraints and other operations
 - Manned and unmanned traffic management – Scalable and heterogeneous operations
- UTM construct consistent with FAA's risk-based strategy
- UTM research platform is used for simulations and tests
- UTM offers path towards scalability

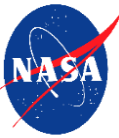
Traffic Management Evolution



http://www.kcet.org/updaily/socal_focus/history/la-as-subject/7th-and-broadway.

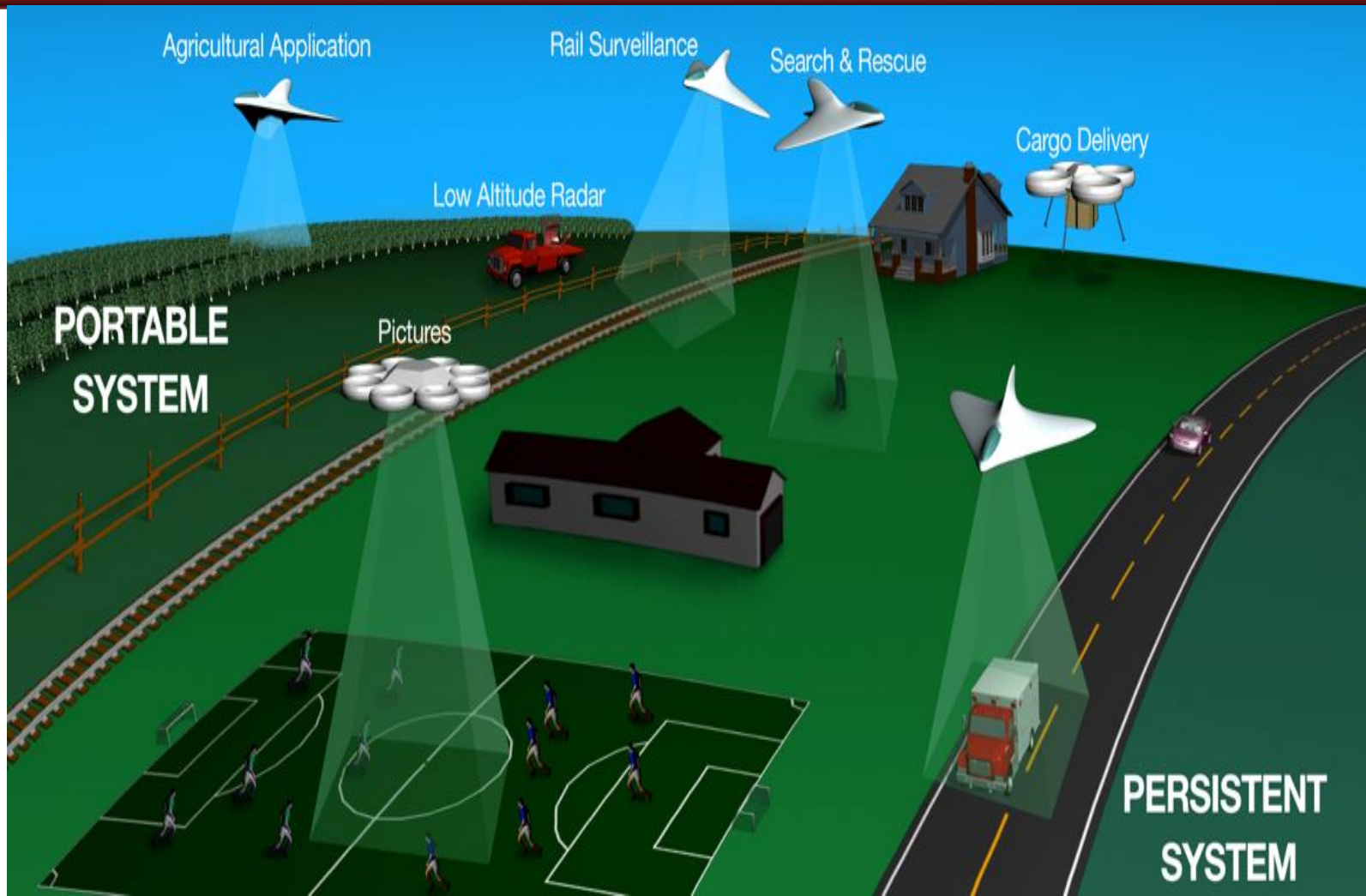
1920, Photo Collection, Los Angeles Public Library

Unmanned Aerial System Traffic Management (UTM)



Near-term Goal: Safely enable initial low-altitude UAS as early as possible

Long-term Goal: Accommodate increased demand with highest safety, efficiency, and capacity



Balancing Multiple Needs

NATIONAL AND REGIONAL SECURITY

Protecting key assets

SAFE AIRSPACE INTEGRATION

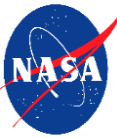
Mantra 1: Flexibility where possible and structure where needed

Mantra 2: Risk based- Geographical needs, application, and performance-based airspace operations

SCALABLE OPERATIONS FOR ECONOMIC GROWTH

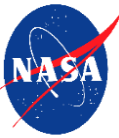
Ever-increasing applications of UAS: Commercial, Agricultural, and Personal

Principles and Services for Safe Integration



- Principles
 - Authenticated users and UAS are allowed to operate in the airspace
 - UAS stay clear of each other
 - UAS and manned aircraft stay clear of each other
 - UAS operator has complete awareness of airspace and other constraints and stay clear of them
 - Public safety UAS have priority over other UAS
- Key UTM related services
 - Authentication
 - Airspace configuration and static and dynamic geo-fence definitions
 - Weather and wind prediction and sensing
 - Conflict avoidance (e.g., airspace notification, V2V)
 - Demand/capacity management
 - Large-scale contingency management – GPS outage, cell outage, etc.
- Research prototype is cloud-based
- UTM research identifies roles and responsibilities of operator, air navigation service provider, and UAS support service providers

UTM Technical Capability Level: Risk-based



Each capability is targeted to type of application, geographical area and uses risk-based approach

CAPABILITY 1 (AUGUST 2015)

- Reservation of airspace volume
- Over unpopulated land or water
- Minimal general aviation traffic in area
- Contingencies handled by UAS pilot
- Enable agriculture, firefighting, infrastructure monitoring

CAPABILITY 3 (JANUARY 2018)

- Beyond visual line of sight
- Over moderately populated land
- Some interaction with manned aircraft
- Tracking, V2V, V2UTM and internet connected
- Public safety, limited package delivery

CAPABILITY 2 (OCTOBER 2016)

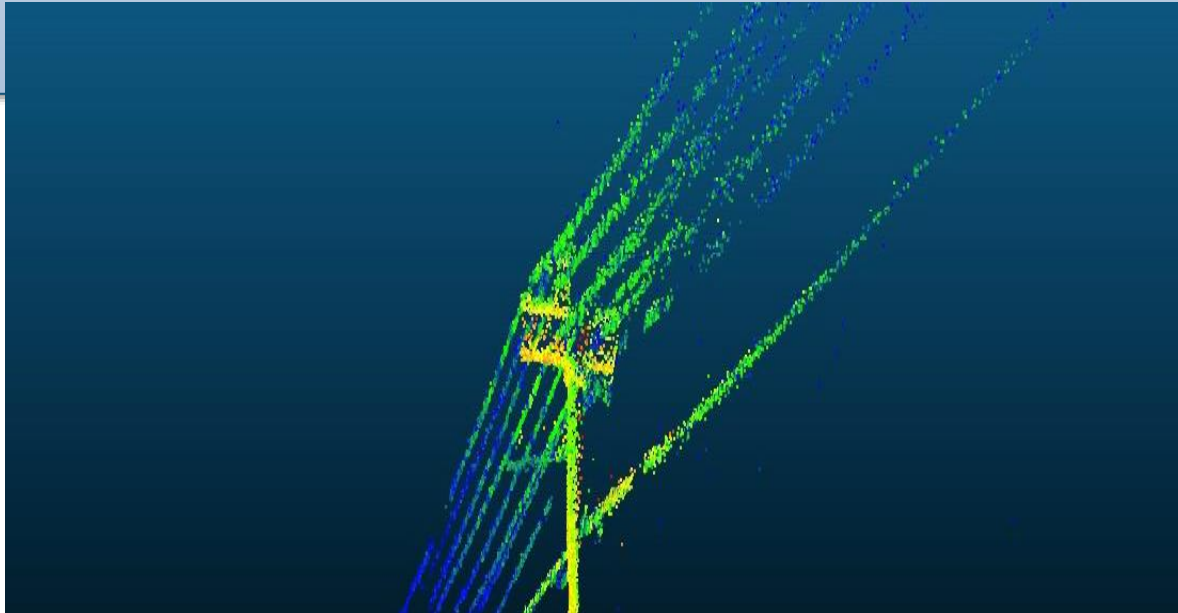
- Beyond visual line-of-sight
- Tracking and low density operations
- Sparsely populated areas
- Procedures and “rules-of-the road”
- Longer range applications

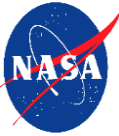
CAPABILITY 4 (MARCH 2019)

- Beyond visual line of sight
- Urban environments, higher density
- Autonomous V2V, internet connected
- Large-scale contingencies mitigation
- News gathering, deliveries, personal use

Opportunities: Research and Technology

- Airspace operations - Beyond visual line of sight autonomous operations
- Tracking and locating every vehicle: Cooperative and non-cooperative
 - Cell/wireless, Automatic Dependent Surveillance, Satellite, localized beacon based systems
- Sense and avoid
 - Other vehicles (V2V) as well as objects such as wires
- Command, control, and communications: cell phone, etc.
- Last/first 50 feet: sensors, hardware, and software for autonomous operations
- Security





Collaborative Research and Next Steps

- NASA works closely with many industry, academia, and government partners
- NASA and FAA have established Research Transition Team (RTT) to collaborate on UTM research – includes DOD, DHS, DOI
- NASA has over 200 collaborators and various work groups
- Test four technical capability levels
- Initial technical capability level 1 was tested, this week being further tested at the FAA test sites
- Capability level 2 will be tested in October
- Continue collaboration with all

Applications of Unmanned Aerial Systems

